

CLAIMS

1. A method of sowing seed comprising the steps of:
 - (a) breaking up soil by pulling laterally spaced apart first tines therethrough with the tines set to penetrate a depth which bears a fixed relationship to the depth at which the seed is to be sown, to create a corresponding plurality of shallow trenches of broken up soil,
 - (b) at a distance behind and in line with each of the first tines, introducing seed to the rear of a second tine via seed delivery means associated therewith, the penetration depth of the second tine being equal to the depth at which the seed is to be sown in the trench, and
 - (c) flattening the soil in the trenches by levelling means aligned with and following the tines.
2. A method as claimed in claim 1 wherein second tines penetrate to substantially the same depth as the first tines.
3. A method as claimed in claim 2 wherein the second tines include lateral wings to break up and lift the soil to facilitate the deposition of seeds at the bottom of each trench.
4. A method as claimed in claim 1 wherein the second tines penetrate to part of the depth of the trenches created by the first tines.
5. A method as claimed in claim 4 wherein laterally extending wings on the second tines lift and spread the soil broken up by the first tines near the top of each trench, and the seed is introduced below the lifted soil, so that the seed is covered by the soil as it drops back into the upper region of each trench.

6. A method as claimed in claim 1 wherein the second tines penetrate to a greater depth than the first tines.
7. A method as claimed in claim 6 wherein the second tines include lateral wings to break up and lift the soil at the bottom of the trenches formed by the second tines to facilitate the deposition of seeds at the bottom of each trench formed by the second tines.
8. Apparatus for cultivating soil and sowing seed comprising:
 - (a) a frame, adapted in use to be towed by, or attached to the rear of, a tractor,
 - (b) a first row of tines carried by the frame and spaced apart across the width of the frame,
 - (c) a second row of tines also carried by the frame and spaced apart across the width of the frame, each of the tines in the second row being aligned with one of the tines in the first row and spaced therefrom in a direction parallel to the direction of forward motion of the apparatus in use,
 - (d) a hopper means containing seed,
 - (e) means for feeding seed therefrom to the rear and underside of each of the second tines,
 - (f) soil levelling means carried by the frame and located in alignment with the tines to the rear of the second row of tines (relative to the said forward direction of motion when in use), so that as the apparatus moves in a forward direction, soil that has been disturbed by the tines is generally flattened by the passage of the levelling means thereover.

9. Apparatus as claimed in claim 8 wherein the penetration depth of at least some of the tines is adjustable relative to the frame.
10. Apparatus as claimed in claim 9 wherein the penetration depth of the first row of tines is adjustable and those in the following row are fixed relative to the frame, the actual depth to which the second row of tines penetrates being governed by the angle made by the frame to the horizontal as determined by its attachment in use to the towing tractor.
11. Apparatus as claimed in claim 8 or 9 wherein all the tines are set to penetrate to a similar depth, so that the seed is delivered near to or at the bottom of each trench of disturbed and broken-up soil.
12. Apparatus as claimed in claim 11 wherein the levelling means comprises levelling tines.
13. Apparatus as claimed in claim 8 or 9 wherein the tines are adjusted so that those in the second row penetrate to only part of the depth penetrated by those in the first row, so that in use the seed will be delivered nearer to the top of each trench.
14. Apparatus as claimed in claim 13 wherein each levelling means comprises a skid plate or a wheel, the height of which is adjustable, to create just sufficient pressure on the soil so as in use to compact the soil above and in the region of the seed, to create good soil to seed contact.
15. Apparatus as claimed in claim 8 or 9 wherein the tines are adjusted so that those in the second row will in use penetrate to a greater depth than those in the first row.
16. Apparatus as claimed in any of claims 8 to 15 wherein the tines in the second row include lateral wings which in use lift the disturbed and broken up soil in the trench created by the first tines, as the second tines move therethrough, to allow seed to fall

below the lifted soil which, as the second tines continue to move forward, will fall back to cover the seed before the soil is flattened by the following levelling means.

17. Apparatus as claimed in any of claims 8 to 16 wherein the pressure exerted on the soil by the levelling means is adjustable.
18. Apparatus as claimed in claim 17 wherein the pressure is selected so that in use the soil below the seed will not be compacted, so as not to impair the aeration and drainage properties created by breaking up the soil below where the seed is to lie.
19. Apparatus as claimed in any of claims 8 to 18 wherein the hopper means containing the seed is a single hopper carried centrally of the frame.
20. Apparatus as claimed in any of claims 8 to 19 wherein in use seed is delivered from the hopper means under gravity to each of the seed delivery means associated with each of the second row of tines.
21. Apparatus as claimed in any of claims 8 to 19 further comprising pneumatically powered seed delivery means which in use operates to deliver seed to the seed delivery means associated with each of the second row of tines.
22. Apparatus as claimed in any of claims 8 to 18 wherein a separate seed hopper is mounted above each of the tines in the second row of tines.
23. Apparatus as claimed in claim 22 wherein in use seed is delivered from each hopper to its associated tine under gravity or by means of a pneumatically powered seed delivery means.
24. Apparatus as claimed in each of claims 8 to 23 wherein the frame is adapted to be attached to a 3-point linkage at the rear of the tractor, so that in use the overall height of the frame and its angle of inclination relative to the ground, can be adjusted.

25. Apparatus as claimed in any of claims 8 to 24 wherein the frame includes depth wheels ahead of the first row of tines.
26. Apparatus as claimed in any of claims 8 to 25 further comprising road wheels and a drawbar which extends forwardly of the frame for attachment to a towing hook on the tractor, to allow the frame to be trailed behind a tractor without using the 3-point linkage.
27. Apparatus as claimed in any of claims 8 to 26 wherein the spaced apart rows of tines and soil levelling means are arranged in parallel spaced apart V formations.
28. Apparatus as claimed in any of claims 8 to 27 wherein each of the tines in the first row comprises a knife or slotter tine which in use is adjusted independently for depth of work.
29. Apparatus as claimed in any of claims 8 to 28 wherein each of the tines in the second row is independently adjustable for depth of work.
30. Apparatus as claimed in any of claims 8 to 29 wherein each of the tines in the second row is provided with or forms a seed spreader outlet to sow seed across the width of the trench to whatever level the second tine penetrates in use.
31. Apparatus as claimed in claim 29 or 30 wherein each of the tines in the second row includes or carries or is fitted with a sweep or A-hoe.
32. Apparatus as claimed in claim 30 or 31 wherein the lateral spacing of the tines and the size of the sweep or A-hoe are selected so that in use seed will be sown in strips which are of the order of 150mm wide separated by unseeded strips which are also of the order of 150mm wide.

33. Apparatus as claimed in any of claims 8 to 32 wherein each of the second tines is a spring tine.
34. Apparatus as claimed in claim 33 wherein the second tines are S-shaped spring tines.
35. Apparatus as claimed in any of claims 8 to 34 wherein wheels are mounted on the frame so that in use they follow the tines to flatten and compact the soil.
36. Apparatus as claimed in claim 35 wherein one wheel is provided for each second tine.
37. Apparatus as claimed in claim 36 wherein each wheel is attached by a rigid arm to the centre of the S-spring, the upper part of the spring serving in use to exert a downward force on the wheel through the arm and thereby through the wheel to the soil.
38. Apparatus as claimed in any of claims 8 to 32 wherein the each of second tines comprises a slotter tine similar to each of the first tines.
39. Apparatus as claimed in claim 38 wherein in use the second tines are adjusted to penetrate to substantially the same depth as the first tines.
40. Apparatus as claimed in claim 39 wherein the soil levelling means comprises wheels or levelling tines, one wheel or set of levelling tines for each second tine.
41. Apparatus as claimed in any of claims 8 to 40 wherein road wheels are attached to the frame and adapted in use to be lowered for trailing the machine behind a tractor and to be raised when the apparatus is to be used for cultivating and sowing.
42. Apparatus as claimed in any of claims 8 to 40 wherein road wheels are removably attached to the frame so that the weight of the machine can be reduced when in use for cultivating and sowing, by removing the wheels.

43. Apparatus as claimed in claim 42 wherein quick release attachment means is provided to allow the road wheels to be mounted and demounted as required.
44. Apparatus as claimed in claim 42 or 43 wherein the wheels are carried on stub axles at the ends of support arms and the latter are pivotably attached to the frame, and raising and lowering is achieved by pivoting the support arms relative to the frame.
45. Apparatus as claimed in claim 41 or 42 which further comprises a screw jack for adjusting the height of the road wheels relative to the frame.
46. Apparatus as claimed in claim 41 or 42 which further comprises hydraulic or pneumatic ram means wherein height adjustment of the road wheels relative to the frame is achieved by supplying hydraulic fluid or air under pressure to the ram means.
47. Apparatus as claimed in any of claims 8 to 46 wherein the frame is constructed from at least two sub-frames which are adapted to be locked in use in two or more configurations, in one of which the sub-frames adopt a layout for drilling (i.e. cultivating and sowing) and in another of which one or more of the sub-frames parts are folded or swung inwardly, to reduce the overall width of the machine for transport on roads or manoeuvring in restricted spaces.
48. Apparatus as claimed in claim 47 wherein at least one of the sub-frames is adapted to overlie at least one other of the sub-frames after it has be folded or swung inwardly.
49. A method of soil cultivation and seed sowing using apparatus as claimed in any of claims 8 to 10 wherein in use the first tines penetrate deeper than the second tines, and in which the first tines are set to penetrate to a depth which is 20 to 170mm deeper than the depth to which the seed is to be delivered.

50. A method of soil cultivation and seed sowing using apparatus as claimed in any of claims 8 to 48 which in use is adapted to cultivate the soil only where the seed is to be planted, thereby creating a conservation tillage by not disturbing the soil between the seeded rows, so that weed seed in the soil between the seeded rows will tend not to germinate because the soil between the rows has not been disturbed.
51. A method of soil cultivation and seeding previously cropped land using apparatus as claimed in any of claim 8 to 48 which in use operates as a direct drill in residue such as straw and stubble of the previous crop, in which the passage of the tines through the soil moves the crop residue onto the soil between the seeded rows, to serve as a mulch.
52. A method of cultivating soil and sowing bean seeds using apparatus as claimed in any of claims 8 to 10 wherein in use the first tines are set so as not to penetrate lower than the second set of tines.
53. A method as claimed in claim 52 wherein the first tines are in use set to penetrate to a reduced depth compared to the depth of penetration of the tines in the second row.
54. A method as claimed in claim 51 wherein prior to the cultivating and sowing step the previous crop residue is chopped and spread evenly over the ground.
55. Methods of cultivation and sowing seed or drilling substantially as described herein.
56. Apparatus for cultivating and sowing or drilling constructed arranged and adapted to be operated substantially as herein described and/or illustrated in the accompanying drawings.